CPC COOPERATIVE PATENT CLASSIFICATION

C30B SINGLE-CRYSTAL-GROWTH (by using ultra-high pressure, e.g. for the formation of diamonds B01J 3/06)

UNIDIRECTIONAL SOLIDIFICATION OF EUTECTIC MATERIAL OR UNIDIRECTIONAL DEMIXING OF EUTECTOID MATERIAL

REFINING BY ZONE-MELTING OF MATERIAL (zone-refining of metals or alloys C22B)

PRODUCTION OF A HOMOGENEOUS POLYCRYSTALLINE MATERIAL WITH DEFINED STRUCTURE (casting of metals, casting of other substances by the same processes or devices B22D ; working of plastics B29 ; modifying the physical structure of metals or alloys C21D , C22F)

SINGLE CRYSTALS OR HOMOGENEOUS POLYCRYSTALLINE MATERIAL WITH DEFINED STRUCTURE

AFTER-TREATMENT OF SINGLE CRYSTALS OR A HOMOGENEOUS POLYCRYSTALLINE MATERIAL WITH DEFINED STRUCTURE (for producing semiconductor devices or parts thereof H01L)

APPARATUS THEREFOR

NOTE

In this subclass, the following expressions are used with the meaning indicated:

- "single-crystal" includes also twin crystals and a predominantly single crystal product;
- "homogeneous polycrystalline material" means a material with crystal particles, all of which have the same chemical composition;
- "defined structure" means the structure of a material with grains which are oriented in a preferential way or have larger dimensions than normally obtained.

In this subclass:

- the preparation of single crystals or a homogeneous polycrystalline material with defined structure of particular materials or shapes is classified in the group for the process as well as in group C30B 29/00;
- an apparatus specially adapted for a specific process is classified in the appropriate group for the process. Apparatus to be used in more than one kind of process is classified in group C30B 35/00.

After the notation of C30B and separated therefrom by a + sign, notations concerning the particular composition or shape of the material may be added. These notations are selected from C30B 29/00.

Example: A crystal-growth process by zone-melting directly related to Al2O3 crystal material is classified in C30B 13/00 + C30B 29/20

WARNING

The following IPC groups are not used in the CPC system. Subject matter

covered by these groups is classified in the following CPC groups:

C30B 29/64, C30B 29/66 covered by C30B 29/60

Guide heading: **Single-crystal growth from solids or gels**

C30B 1/00 **Single-crystal growth directly from the solid state** (unidirectional demixing of eutectoid materials C30B 3/00; under a protective fluid C30B 27/00)

C30B 1/02 . by thermal treatment, e.g. strain annealing (C30B 1/12 takes precedence)
C30B 1/023 . . {from solids with amorphous structure }
C30B 1/026 . . {Solid phase epitaxial growth through a disordered intermediate layer }
C30B 1/04 . . Isothermal recrystallisation
C30B 1/06 . . Recrystallisation under a temperature gradient
C30B 1/08 . . . Zone recrystallisation

C30B 1/10 . by solid state reactions or multi-phase diffusion

C30B 1/12 . by pressure treatment during the growth

C30B 3/00 **Unidirectional demixing of eutectoid materials**

C30B 5/00 **Single-crystal growth from gels** (under a protective fluid C30B 27/00)

C30B 5/02 . with addition of doping material

Guide heading: **Single-crystal growth from liquids**
Unidirectional solidification of eutectic materials

C30B 7/00 **Single-crystal growth from solutions using solvents which are liquid at normal temperature, e.g. aqueous solutions** (from molten solvents C30B 9/00; by normal or gradient freezing C30B 11/00; under a protective fluid C30B 27/00)

C30B 7/005 . { Epitaxial layer growth }

WARNING

Group C30B 7/005 is not complete, see also C30B 7/00

C30B 7/02 . by evaporation of the solvent
C30B 7/04 . . using aqueous solvents
C30B 7/06 . . using non-aqueous solvents

C30B 7/08 . by cooling of the solution

C30B 7/10 . by application of pressure, e.g. hydrothermal processes

C30B 7/105 . . { using ammonia as solvent, i.e. ammonothermal processes }

C30B 7/12 . by electrolysis

C30B 7/14 . the crystallising material being formed by chemical reactions in the solution

C30B 9/00 **Single-crystal growth from melt solutions using molten solvents** (by normal or gradient freezing C30B 11/00; by zone-melting C30B 13/00; by crystal pulling C30B 15/00; on immersed seed crystal C30B 17/00; by liquid phase epitaxial growth C30B 19/00; under a protective fluid C30B 27/00)

C30B 9/02 . by evaporation of the molten solvent

C30B 9/04 . by cooling of the solution

C30B 9/06 . . using as solvent a component of the crystal composition

C30B 9/08 . . using other solvents

C30B 9/10 . . . Metal solvents

C30B 9/12 . . . Salt solvents, e.g. flux growth

C30B 9/14 . by electrolysis

C30B 11/00 **Single-crystal growth by normal freezing or freezing under temperature gradient, e.g. Bridgman-Stockbarger method** (C30B 13/00, C30B 15/00, C30B 17/00, C30B 19/00 take precedence; under a protective fluid C30B 27/00)

C30B 11/001 . {Continuous growth }

C30B 11/002 . {Crucibles or containers for supporting the melt }

C30B 11/003 . {Heating or cooling of the melt or the crystallised material }

C30B 11/005 . {by irradiation or electric discharge }

C30B 11/006 . {Controlling or regulating }

C30B 11/007 . {Mechanisms for moving either the charge or the heater }

C30B 11/008 . {using centrifugal force to the charge }

C30B 11/02 . without using solvents (C30B 11/06 takes precedence)

C30B 11/04 . adding crystallising material or reactants forming it in situ to the melt

C30B 11/06 . . at least one but not all components of the crystal composition being added

C30B 11/065 . . . {before crystallising, e.g. synthesis }

C30B 11/08 . . every component of the crystal composition being added during the crystallisation

C30B 11/10 . . . Solid or liquid components, e.g. Verneuil method

C30B 11/12 . . . Vaporous components, e.g. vapour-liquid-solid-growth

C30B 11/14 . characterised by the seed, e.g. its crystallographic orientation

C30B 13/00 **Single-crystal growth by zone-melting**
Refining by zone-melting (C30B 17/00 takes precedence; by changing the cross-section of the treated solid C30B 15/00; under a protective fluid C30B 27/00; zone-refining of specific materials, see the relevant subclasses for the materials)

C30B 13/005 . {Continuous growth }

C30B 13/02 . Zone-melting with a solvent, e.g. travelling solvent process

C30B 13/04 . Homogenisation by zone-levelling

C30B 13/06 . the molten zone not extending over the whole cross-section

C30B 13/08 . adding crystallising material or reactants forming it in situ to the molten zone

C30B 13/10 . . with addition of doping material

C30B 13/12 . . . in the gaseous or vapour state

C30B 13/14 . Crucibles or vessels

C30B 13/16 . Heating of the molten zone

C30B 13/18 . . the heating element being in contact with, or immersed in, the molten zone

C30B 13/20 . . by induction, e.g. hot wire technique (C30B 13/18 takes precedence; induction coils H05B 6/36)

C30B 13/22 . . by irradiation or electric discharge

C30B 13/24 . . . using electromagnetic waves

C30B 13/26 . Stirring of the molten zone

C30B 13/28 . Controlling or regulating (controlling or regulating in general G05)

C30B 13/285 . . {Crystal holders, e.g. chucks }

C30B 13/30 . . Stabilisation or shape controlling of the molten zone, e.g. by concentrators, by electromagnetic fields
Controlling the section of the crystal

C30B 13/32 . Mechanisms for moving either the charge or the heater

C30B 13/34 . characterised by the seed, e.g. by its crystallographic orientation

C30B 15/00 **Single-crystal growth by pulling from a melt, e.g. Czochralski method** (under a protective fluid C30B 27/00)

C30B 15/002 . {Continuous growth }

C30B 15/005 . {Simultaneous pulling of more than one crystal }

C30B 15/007 . {Pulling on a substrate }

C30B 15/02 . adding crystallising material or reactants forming it in situ to the melt
C30B 15/04 . . adding doping material, e.g. for n-p-junction

C30B 15/06 . Non-vertical pulling

C30B 15/08 . Downward pulling

C30B 15/10 . Crucibles or containers for supporting the melt
C30B 15/12 . . Double crucible methods

C30B 15/14 . Heating of the melt or the crystallised material
C30B 15/16 . . by irradiation or electric discharge
C30B 15/18 . . using direct resistance heating in addition to other methods of heating, e.g. using Peltier heat

C30B 15/20 . Controlling or regulating (controlling or regulating in general G05)
C30B 15/203 . . { the relationship of pull rate (v) to axial thermal gradient (G) }
C30B 15/206 . . { the thermal history of growing the ingot }
C30B 15/22 . . Stabilisation or shape controlling of the molten zone near the pulled crystal Controlling the section of the crystal
C30B 15/24 . . . using mechanical means, e.g. shaping guides (shaping dies for edge-defined film-fed crystal growth C30B 15/34)
C30B 15/26 . . . using television detectors
using photo or X-ray detectors
C30B 15/28 . . . using weight changes of the crystal or the melt, e.g. flotation methods

C30B 15/30 . Mechanisms for rotating or moving either the melt or the crystal (flotation methods C30B 15/28)
C30B 15/305 . . {Stirring of the melt }

C30B 15/32 . Seed holders, e.g. chucks

C30B 15/34 . Edge-defined film-fed crystal-growth using dies or slits

C30B 15/36 . characterised by the seed, e.g. its crystallographic orientation

C30B 17/00 **Single-crystal growth onto a seed which remains in the melt during growth, e.g. Nacken-Kyropoulos method** (C30B 15/00 takes precedence)

C30B 19/00 **Liquid-phase epitaxial-layer growth**

C30B 19/02 . using molten solvents, e.g. flux
C30B 19/04 . . the solvent being a component of the crystal composition

C30B 19/06 . Reaction chambers

Boats for supporting the melt
Substrate holders

C30B 19/061 . . {Tipping system, e.g. by rotation }
C30B 19/062 . . {Vertical dipping system }
C30B 19/063 . . {Sliding boat system }
C30B 19/064 . . {Rotating sliding boat system }
C30B 19/065 . . {Multiple stacked slider system }
C30B 19/066 . . {Injection or centrifugal force system }
C30B 19/067 . . {Boots or containers }
C30B 19/068 . . {Substrate holders }

C30B 19/08 . Heating of the reaction chamber or the substrate

C30B 19/10 . Controlling or regulating (controlling or regulating in general G05)
C30B 19/103 . . {Current controlled or induced growth }
C30B 19/106 . . {adding crystallising material or reactants forming it in situ to the liquid }

C30B 19/12 . characterised by the substrate

C30B 21/00 **Unidirectional solidification of eutectic materials**

C30B 21/02 . by normal casting or gradient freezing

C30B 21/04 . by zone-melting

C30B 21/06 . by pulling from a melt

Guide heading: **Single-crystal growth from vapours**

C30B 23/00 **Single-crystal growth by condensing evaporated or sublimed material**

NOTE

Groups C30B 23/002 to C30B 23/00D take precence over groups C30B 23/007 to C30B 23/08

WARNING

Group C30B 23/002 to C30B 23/00D are not complete, see also C30B 23/02

C30B 23/002 . { Controlling or regulating }
C30B 23/005 . . { Controlling or regulating flux or flow of depositing species or vapour }

C30B 23/007 . {Growth of whiskers or needles }

C30B 23/02 . Epitaxial-layer growth

C30B 23/025 . . { characterised by the substrate }

C30B 23/04 . . Pattern deposit, e.g. by using masks

C30B 23/06 . . Heating of the deposition chamber, the substrate or the material to be evaporated

C30B 23/063 . . . { Heating of the substrate }

WARNING

Group C30B 23/063 is not complete, see also C30B 23/06

C30B 23/066 . . . { Heating of the material to be evaporated }

WARNING

Group C30B 23/066 is not complete, see also C30B 23/06

C30B 23/08 . . by condensing ionised vapours (by reactive sputtering C30B 25/06)

C30B 25/00 Single-crystal growth by chemical reaction of reactive gases, e.g. chemical vapour-deposition growth

C30B 25/005 . {Growth of whiskers or needles }

C30B 25/02 . Epitaxial-layer growth

C30B 25/025 . . {Continuous growth }

C30B 25/04 . . Pattern deposit, e.g. by using masks

C30B 25/06 . . by reactive sputtering

C30B 25/08 . . Reaction chambers
Selection of material therefor

C30B 25/10 . . Heating of the reaction chamber or the substrate

C30B 25/105 . . . {by irradiation or electric discharge }

C30B 25/12 . . Substrate holders or susceptors

C30B 25/14 . . Feed and outlet means for the gases
Modifying the flow of the reactive gases

C30B 25/16 . . Controlling or regulating (controlling or regulating in general G05)

C30B 25/165 . . . { the flow of the reactive gases }

WARNING

Not complete pending reclassification, see also group C30B 25/14

C30B 25/18 . . characterised by the substrate

C30B 25/183 . . . { being provided with a buffer layer, e.g. a lattice matching layer }

WARNING

This group is not complete pending reclassification; see also C30B 25/18 and subgroups

C30B 25/186 . . . { being specially pre-treated by e.g. chemical or physical means }

C30B 25/20 . . . the substrate being of the same material as the epitaxial layer
C30B 25/205 . . . . {the substrate being of insulating material }
C30B 25/22 . . Sandwich processes

C30B 27/00 **Single-crystal growth under a protective fluid**

C30B 27/02 . by pulling from a melt

C30B 28/00 **Production of homogeneous polycrystalline material with defined structure**

C30B 28/02 . directly from the solid state

C30B 28/04 . from liquids
C30B 28/06 . . by normal freezing or freezing under temperature gradient
C30B 28/08 . . by zone-melting
C30B 28/10 . . by pulling from a melt

C30B 28/12 . directly from the gas state
C30B 28/14 . . by chemical reaction of reactive gases

C30B 29/00 **Single crystals or homogeneous polycrystalline material with defined structure characterised by the material or by their shape** (alloys C22C)

NOTE

In groups C30B 29/02 to C30B 29/58, in the absence of an indication to the contrary, a material is classified in the last appropriate place.

C30B 29/02 . Elements
C30B 29/04 . . Diamond
C30B 29/06 . . Silicon
C30B 29/08 . . Germanium

C30B 29/10 . Inorganic compounds or compositions
C30B 29/12 . . Halides
C30B 29/14 . . Phosphates
C30B 29/16 . . Oxides
C30B 29/18 . . . Quartz
C30B 29/20 . . . Aluminium oxides
C30B 29/22 . . . Complex oxides
C30B 29/225 . . . . { based on rare earth copper oxides, e.g. high T-superconductors }
C30B 29/24 . . . . with formula AMeO3, wherein A is a rare earth metal and Me is Fe, Ga, Sc, Cr, Co or Al, e.g. ortho ferrites
C30B 29/26 . . . . with formula BMe2O4, wherein B is Mg, Ni, Co, Al, Zn, or Cd and Me is Fe, Ga, Sc, Cr, Co, or Al

C30B 29/28 .... with formula A3Me5O12 wherein A is a rare earth metal and Me is Fe, Ga, Sc, Cr, Co or Al, e.g. garnets

C30B 29/30 .... Niobates
Vanadates
Tantalates

C30B 29/32 .... Titanates
Germanates
Molybdates
Tungstates

C30B 29/34 .. Silicates

C30B 29/36 .. Carbides

C30B 29/38 .. Nitrides

C30B 29/40 .. AIIIBV compounds {wherein A is B, Al, Ga, In or Tl and B is N, P, As, Sb or Bi }

C30B 29/403 ... AIII-nitrides

C30B 29/406 .... Gallium nitride

C30B 29/42 ... Gallium arsenide

C30B 29/44 ... Gallium phosphide

C30B 29/46 .. Sulfur-, selenium- or tellurium-containing compounds

C30B 29/48 ... AIIBVI compounds {wherein A is Zn, Cd or Hg, and B is S, Se or Te }

C30B 29/50 .... Cadmium sulfide

C30B 29/52 .. Alloys

C30B 29/54 . Organic compounds

C30B 29/56 .. Tartrates

C30B 29/58 .. Macromolecular compounds

C30B 29/60 . characterised by shape

C30B 29/602 .. { Nanotubes }

C30B 29/605 .. {Products containing multiple oriented crystallites, e.g. columnar crystallites }

C30B 29/607 .. {Crystals of complex geometrical shape, e.g. tubes, cylinders } (nanotubes 29/60B)

WARNING

Group C30B 29/607 is not complete, see also C30B 29/60B, C30B 29/60D

C30B 29/62 .. Whiskers or needles

C30B 29/64 .. Flat crystals, e.g. plates, strips, disks

WARNING

This group is not complete pending reclassification; see also C30B 29/60 and subgroups

C30B 29/66 .. Crystals of complex geometrical shape, e.g. tubes, cylinders

WARNING

This group is not complete pending reclassification; see also C30B 29/60 and subgroups

C30B 29/68 . . Crystals with laminate structure, e.g. "superlattices"

C30B 30/00 **Production of single crystals or homogeneous polycrystalline material with defined structure characterised by the action of electric or magnetic fields, wave energy or other specific physical conditions**

NOTE

When classifying in this group, classification is also made in groups C30B 1/00 to C30B 27/00 according to the process of crystal growth.

C30B 30/02 . using electric fields, e.g. electrolysis

C30B 30/04 . using magnetic fields

C30B 30/06 . using mechanical vibrations

C30B 30/08 . in conditions of zero-gravity or low gravity

Guide heading: **After-treatment of single crystals or homogeneous polycrystalline material with defined structure**

C30B 31/00 **Diffusion or doping processes for single crystals or homogeneous polycrystalline material with defined structure**
Apparatus therefor

C30B 31/02 . by contacting with diffusion material in the solid state

C30B 31/04 . by contacting with diffusion material in the liquid state

C30B 31/045 . . {by electrolysis }

C30B 31/06 . by contacting with diffusion material in the gaseous state (C30B 31/18 takes precedence)

C30B 31/08 . . the diffusion material being a compound of the elements to be diffused

C30B 31/10 . . Reaction chambers
Selection of material therefor

C30B 31/103 . . . {Mechanisms for moving either the charge or heater }

C30B 31/106 . . . {Continuous processes }

C30B 31/12 . . Heating of the reaction chamber

C30B 31/14 . . Substrate holders or susceptors

C30B 31/16 . . Feed and outlet means for the gases
Modifying the flow of the gases

C30B 31/165 . . . {Diffusion sources }

C30B 31/18 . . Controlling or regulating (controlling or regulating in general G05)

C30B 31/185 . . . {Pattern diffusion, e.g. by using masks }

C30B 31/20 . Doping by irradiation with electromagnetic waves or by particle radiation

C30B 31/22 . . by ion-implantation

C30B 33/00 **After-treatment of single crystals or homogeneous polycrystalline material with defined structure** (C30B 31/00 takes precedence; grinding, polishing B24 ; mechanical fine working of gems, jewels, crystals B28D 5/00)

C30B 33/005 . {Oxydation }

C30B 33/02 . Heat treatment (C30B 33/04, C30B 33/06 take precedence)

C30B 33/04 . using electric or magnetic fields or particle radiation

C30B 33/06 . Joining of crystals

C30B 33/08 . Etching

C30B 33/10 . . in solutions or melts

C30B 33/12 . . in gas atmosphere or plasma

C30B 35/00 **Apparatus in general, specially adapted for the growth, production or after-treatment of single crystals or a homogeneous polycrystalline material with defined structure**

C30B 35/002 . {Crucibles or containers }

C30B 35/005 . {Transport systems }

C30B 35/007 . { Apparatus for preparing, pre-treating the source material tio be used for crystal growth }

WARNING

This group is not complete pending reclassification; see also groups pertaining to the different crystal growth methods, particularly the main groups of subclass C30B